NOTES ON UTILITY AND PERFORMANCE OF COMPOUND METERS[1]

By Fred B. Nelson

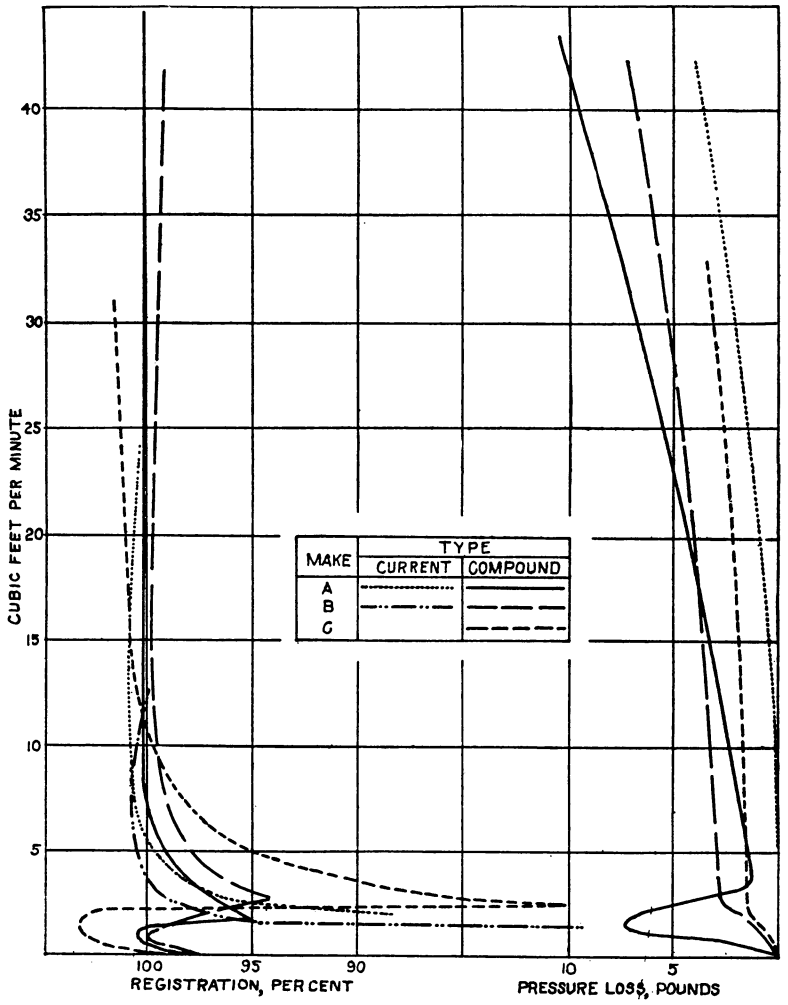
What the author has to say about compound meters is not based on experience with them in service nor on elaborate study of their principles and performance, and departmental tests and investigations in New York have not to date been sufficient to warrant positive conclusions or elaborate treatment of the subject. If, therefore, the author merely mentions some phases of the topic which will bring out discussion from those who have had experience in their design or use, the purpose of the paper will be met.

The compound meter designed to obviate the loss of registration on flows too small for accurate measurement by the full-line-size meter consists essentially of three units, a large meter, a small by-pass meter and a regulating valve so arranged that as the flow through the by-pass reaches a reasonable capacity of the small meter, the pressure loss actuates the regulating valve which opens and deflects all or part of the flow to the larger meter.

At the present time, compound meters as such are not on the approved list for use in New York City, but the advisability of their use in saving revenue on numerous large and often over-size installations has been considered, particularly in the past one or two years. Nearly a year ago, tests were made on fifteen current meters in service, from 3 to 6 inches, inclusive, in size, to determine the amount of under-registration in actual service. These tests were arranged by inserting a small meter in a by-pass around the outlet valve of the large meter; thus, with the outlet valve closed, the meters would be working in series, each under the variation of rates produced by the actual service demand. The duration of the tests was from one week to five months of continuous operation. The results showed a total monthly registration on test meters of 828,229 cubic feet against 651,642 by the service meters, an under-registration of 176,587 or 21.3 per cent, representing on the 15 meters

[1] Read before the New York Section on February 19, 1919.

a revenue loss of $176.58 per month or $2119 per annum. Out of the 15 service meters, three over-registered 2, 4 and 11 per cent respectively. The under-registrations of the other 12 ran from 6 to 95 per cent. While the results secured on these meters may not be accurately representative, they are at least suggestive of the



Tests by Department of Water Supply, Gas and Electricity, New York City, of performance of four-inch compound meters, including comparison with performance of current meters of the same makes and size.

possible loss of revenue being sustained by lack of proper compounding of the 3500 odd meters 3 inches and larger now in service in the city. If the tests were representative of the actual conditions, the annual loss to the city would be upwards of one-half million dollars.

Other and more striking examples might be mentioned as illustrations of the possible saving to be secured by compounding. In one instance, the replacing of an old 8-inch standard meter by a compound combination of an 8-inch current meter, 8-inch regulating valve and 2-inch by-pass meter, resulted in raising the monthly registration from 1645 to 56,480 cubic feet, a saving of $650 per year.

Tests for accuracy and pressure loss at varying rates of flow have to date been made by the department on five makes of 4-inch compound meters. By a study of the resulting curves some features of possible improvement are suggested.

On all meters tested, the by-pass meter, usually about $\frac{3}{4}$ inch, is sufficiently small to register with accuracy, very minute flows, as low as 0.01 cubic foot per minute, but, on the other hand, it does not seem to be of sufficient capacity to carry the load to a rate which can be accurately registered on the large meter before reaching the pressure loss at which the regulating valve opens, resulting in an under-registration immediately following the opening of the valve and between the total rates of about $1\frac{1}{2}$ and 3 or 4 cubic feet a minute. It would seem from the average curves obtained, that accuracy at these rates, which could easily represent a large portion of actual use or continuous fixture leakage, was being sacrificed in order to secure registration of the extremely small flows of say less than 0.1 cubic foot per minute which on all services of this size are relatively unimportant.

Under-registration of such service flows may also be due in a large measure to the very gradual opening of the regulating valve, while the by-pass meter, subjected, as in some makes, to the same pressure difference, continues to operate on high flow, leaving the increase of flow only to be deflected through the larger meter with but slight, if any registration. For example, assume that the rate is increased to 2 cubic feet a minute with the regulating valve at the point of opening and the by-pass meter registering the total flow accurately. Then if the rate is increased to $2\frac{1}{2}$ cubic feet per minute with a slight opening of the regulating valve and no decrease

in pressure loss the by-pass meter will continue to register a full 2 cubic feet accurately and the $\frac{1}{2}$ cubic foot only will pass through the current meter without registration so that the combination would under-register $\frac{1}{5}$ or 20 per cent. Instead of this gradually opening regulating valve it would seem that one designed to more abruptly deflect practically the full flow from the by-pass to the main line would be preferable, this action to be accomplished either by mechanical closing of the by-pass or a sufficient valve opening to materially decrease the pressure loss and the resulting by-pass flow.

On some compound meters the stem of the regulating valve carries within a cylinder a small, close fitting piston, one side of which receives the water pressure of the main tending to hold the valve closed while the other side of the piston is open to atmosphere. If this piston were so designed that a slight opening movement of the valve would allow water pressure to replace the atmospheric, an opening impulse would be given the valve tending to suddenly reduce the pressure loss, thereby transferring a large portion of the by-pass flow to the large meter and favoring its more accurate registration. Possibly meter manufacturers can point out the impractical phases of this proposition.

A valve of this type partially open to atmosphere has a tendency to open more easily under low main pressure, thus deflecting the flow to the large meter at a lower rate than when working under a high main pressure, a matter which is probably compensated for by varying the weight of the valve.

From these more or less superficial observations, the following improvements are suggested:

1. An increase in the capacity of the by-pass meter to cover all service rates too small for accurate registration on the main line meter and at a pressure loss that is sufficiently low to avoid opening of the regulating valve until the flow is well within the range for accuracy on the large meter.

2. A regulating valve so designed as to open more abruptly with either simultaneous closing of the by-pass or with a sufficient reduction of pressure loss to materially relieve the by-pass meter and deflect the bulk of its flow through the main line, thereby setting up a flow through the main line sufficient for accurate registration on the large meter.